Final Report

Arizona Game and Fish Department

Heritage Project

I95018

Apache Trout Stream Survey
Lee Valley, Coyote, and Mamie Creeks

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Table of Contents

Note: Station photographs on file at the Pinetop Regional Office of the Arizona Game & Fish Department.

Introduction

In 1995, the Springerville Ranger District of the Apache-Sitgreaves National Forests (Forest), received an Arizona Game and Fish Department Heritage Grant (I95018). The purpose of this grant was to survey fish habitat conditions and fish populations in Lee Valley, Coyote and Mamie Creeks.

The Apache trout (*Oncorhynchus apache*) was listed as an endangered species in 1973, then down listed to threatened status in 1975 (USFWS 1983). A recovery plan for the Apache trout was first completed in 1979, then revised in 1983. One goal of the recovery plan is to establish and/or maintain 30 self-sustaining discrete populations of pure Arizona trout throughout its historic range (USFWS 1983). The Lee Valley Creek and Coyote/Mamie Creek populations are two of the 30 populations considered necessary for the recovery and delisting of the Apache trout.

The Forest Plan recognized the importance and distinctive values of riparian areas and fisheries habitats by establishing management objectives to be measured by standards and guidelines. Management emphasis will be directed at areas with riparian dependent resources in the following order of priority: 1) threatened and endangered species; 2) cold water fisheries; 3) warm water fisheries; and 4) all other riparian areas (USFS 1989). The Forest Plan Monitoring Plan calls for a Level III General Aquatic Wildlife Survey (GAWS) on priority one and two streams every five years. Lee Valley and Coyote/Mamie Creeks are priority one streams. This is the basis for the current surveys, as Lee Valley, Coyote, and Mamie Creeks were last surveyed in 1990. These surveys were conducted in July 1995 and included evaluation of fish population, aquatic habitat, riparian, and water quality conditions. This report summarizes the results of the

surveys, compares results of this survey with results obtained in the 1990 surveys, and makes management recommendations to improve riparian and fish habitat conditions for Lee Valley, Mamie, and Coyote Creeks.

Survey Information

Lee Valley Creek

Lee Valley Creek is in Apache County on the Apache-Sitgreaves National Forests. The creek is a 2.6 kilometer (1.6 mile) northeasterly flowing tributary of the East Fork of the Little Colorado River. The drainage area of this watershed is approximately 2.8 square kilometers (1.1 square miles). It ranges in elevation from 2871 meters (9418 feet) at the confluence with Lee Valley Reservoir to 2993 meters (9820 feet) at station 15, the uppermost stream area surveyed (Appendix A, Figures A-1 and A-2).

Lee Valley Creek is a small, second order stream originating from spring flow near the top of Mount Baldy. It flows through two distinct forested reaches and then a meadow reach, before being impounded at Lee Valley Reservoir. The streams watershed is a combination of high mountain meadows and spruce-fir forest.

The Arizona Game and Fish Department Fish Management Report (AGFD 1991) for Lee Valley Creek recommended that livestock be excluded from Reach 1 until satisfactory habitat conditions were achieved. The Apache Trout Habitat Improvement Plan (USFS 1995) states that the Lee Valley Pasture within the Voigt Allotment should be rested from livestock grazing until the Allotment Management Plans are revised. All reaches are located in the Lee Valley pasture. This pasture was rested beginning in the 1993 grazing season. Since the last survey in 1990, the pasture was moderately to heavily grazed in 1990, 1991, and 1992. The mean ungulate damage

rating decreased from 18.6% in 1990 to 1.0% in 1995. Average embeddedness ratings also decreased from 53.1% in 1990 to 32.0% in 1995. The mean riparian condition rating increased from 4.9 in 1990 (which is unsatisfactory), to 10.3 in 1995 (which is satisfactory).

Water Quality

Limited water quality sampling was conducted during the present survey (1995). Water analyses conducted in 1982 characterized Lee Valley Creek as a clean water stream. Nutrient and hardness levels were indicative of low to moderate trout production potential. A summary of the water analyses completed during the present survey are presented in Table 1.

Table 1. Lee Valley Creek Water Chemistry, July 1995.

Station Number	1 - 5	2 - 10	3 - 15	Stream Avg.
Date	6/13	6/14	6/14	---
Time	0850	1400	0915	---
Water Temperature (EC)	7	9.4	7.2	7.9
pH	7	7	7	7
Alkalinity (mg/l)	172	84	99	118
Sulphate (mg/l)	1	1	1	1
Specific Conductance (Fmhos/cm at 25EC)	34	32	32	33
Dissolved Oxygen	9.24	9.06	9.38	9.20

Habitat

Lee Valley Creek was divided into three distinct reaches for sampling purposes. Each reach had three, 50 meter sampling stations (see Appendix A, Figure A-1). Lee Valley Creek provides approximately 0.27 hectares (0.66 acres) of coldwater fisheries habitat over the stream course surveyed. It is a shallow stream with a mean water width of 2.2 meters (7.2 feet), mean

water depth of 0.13 meters (0.42 feet), and a mean width to depth ratio of 22.8. The average stream gradient was 4.6%. Figure B-1 shows a comparison of the Habitat Condition Indexes (HCI-s) for the two survey years.

The first reach is a low gradient meadow reach, with an average gradient of 2.0%. The habitat condition index (HCI) for this reach was 55.8% in 1995 (Table 2), which is below the Forests 60% minimum standard for trout streams. The HCI did increase from 52.3% in 1990 (Table 3). The pool measure and pool structure ratings for this reach decreased from 1990 to 1995. In 1990, the ratings in terms of both availability and quality of pool habitat, indicated fair conditions. The 1995 survey data for pool measure and pool structure suggested poor conditions (Appendix B, Figure B-2). Undercut banks were still present in this reach. The percent embeddedness for this reach decreased but is still at unacceptable levels (Appendix B, Figure B-3). The ungulate damage ratings decreased to acceptable levels (Appendix B, Figure B-4). Canopy density also decreased (Appendix B, Figure B- 5). Reach 1 supported 7.5 hectares (18.5 acres) of riparian habitat that was in fair condition during the present survey.

Reach 2 of Lee Valley Creek is a high gradient, heavily forested reach, with a majority of stream habitat being riffle area. The HCI for this reach decreased from 62.2% in 1990 (Table 3) to 42.2% in 1995 (Table 2). The most significant decrease was in the pool measure and structure ratings (Appendix B, Figure B-6). The riparian condition averaged 12 on the scorecard used, which indicated that the riparian habitat was in excellent condition. It was noted that there was an abundance of downed trees in this reach and in reach 3, which may be a factor in the decreased canopy densities (Appendix B, Figure B- 5).

Reach 3 is also a high gradient forested reach. The majority of stream habitat was measured as riffle area. The HCI for this reach decreased from 58.4% in 1990 to 47.4% in 1995 (Table 2). Riparian condition ratings averaged 12 on the scorecards used, indicating that riparian habitat was in excellent condition. Bank stability ratings were fair (Appendix B, Figure B-7). Embeddedness and ungulate damage ratings decreased to acceptable levels (Figures B-3 and B-4). In 1990 the canopy density was more than 80%. In 1995 the canopy density rating for reach 3 was 56% (Figure B-5).

Fish Populations

Arizona Game and Fish Department stocking records indicate that Lee Valley Reservoir has been stocked with Brook trout (*Salvelinus fontinalis*) as early as 1953, grayling (*Thymallus arcticus*) in 1965, and Apache trout in 1968. The brook trout displaced the native trout and the native bluehead suckers by at least 1977. In 1979, a fish barrier was constructed on Lee Valley Creek just above the reservoir. The stream was chemically treated in June 1982 to remove all fish present in the creek. Pure Apache trout were reintroduced later the same year. The fish barrier failed in 1983. Lee Valley Creek was renovated again in 1987, and restocked with Apache trout in 1988. A survey using GAWS methodology and riparian scorecards was carried out in 1990, but no fish population surveys were conducted. The 1995 survey showed that the barrier has again failed to control non-native migration.

Two species of fish were captured in Lee Valley Creek during electroshocking efforts in 1995. A total of 10 brook trout and three Apache trout were captured, measured, weighed and released (Figures B-8 and B-9). One brook trout was captured in reach 1, nine brook trout and three Apache trout were captured in reach 2, and no fish were captured in reach 3 (Table 4).

Table 2. Summary of Habitat Conditions on Lee Valley Creek, 1995.

Stream Reach	1	2	3	Total or Stream Average
Reach Length (m)	1300	580	715	2595 (total)
Reach Area (m^2)	628.0	188.0	290.5	1106.5 (total)
Number of Stations	3	3	3	9 (total)
Elevation (m)	2880	2915	2967	2921
Gradient (%)	2.0	5.1	6.8	4.6
Riffle (%)	17.4	96.7	39.2	51.1
Potential Spawning Area (%)	11.9	49.3	55.7	39.0
Potential Rearing Area (%)	12.2	0.0	6.2	6.1
Channel Width (m)	6.3	3.8	5.3	5.1
Water Width (m)	5.0	1.5	2.4	2.2
Water Depth (m)	0.2	0.09	0.09	0.13
Water Width/Depth Ratio[1]	25	16.7	26.7	22.8
Pool Measure (%)[2]	9.3	0.0	15.9	8.4
Pool Structure (%)[2]	33.3	0.0	0.0	11.1
Gravel Bottom (%)[2]	63.9	68.2	65.5	65.9
Bank Cover (%)[3]	64.2	60.0	68.3	64.2
Bank Soil Stability (%)[3]	80.8	64.2	70.8	71.9
Bank Vegetation Stability (%)[3]	83.3	60.8	65.0	69.7
Canopy Density (%)[3]	24.0	60.0	56.0	46.7
Ungulate Damage (%)[4]	0.3	1.6	1.0	0.97
Embeddedness (%)[4]	56.5	26.9	12.7	32.0
Habitat Condition Index (HCI %)[5]	55.8	42.2	47.6	48.5
Habitat Vulnerability Index (HVI%)[6]	66.4	58.3	61.8	62.2
Riparian Condition[7]	7	12	12	10.3
Riparian Area (ha)	7.5	2.3	0.49	10.29 (total)

[1]- <15 Good; 16-25 Fair; >26 Poor
[2]- >70% Good; 40-69% Fair; <39%Poor

[3]- >80% Good; 40-79% Fair; <39%Poor
[4]- <25% Good; 26-50% Fair; >51%Poor
[5]- >60% Good; 40-59% Fair; <39%Poor
[6]- <45% Good; 46-59% Fair; >60%Poor
[7]- 9-12 Moderately high -High; 6-8 Moderate: 0-5 Low - Moderately low

Table 3. A summary of habitat conditions at Lee Valley Creek, 1990 (Reach length, area, number of stations, elevation and gradient are not included in 1990 summaries, assume similar numbers as in 1995 summaries).

Stream Reach	1	2	3	Total or Stream Average
Riffle (%)	75.4	82.7	84.0	81.0
Potential Spawning Area (%)	23.3	46.6	43.8	38.7
Potential Rearing Area (%)	24.6	17.3	17.4	19.5
Channel Width (m)	5.5	2.5	2.8	4.1
Water Width (m)	0.6	1.5	1.4	1.0
Water Depth (m)	0.03	0.03	0.03	0.03
Water Width/Depth Ratio[1]	20.0	50.0	47.0	03.
Pool Measure (%)[2]	43.3	32.9	30.6	35.1
Pool Structure (%)[2]	53.3	33.3	33.3	39.2
Gravel Bottom (%)[2]	25.5	51.6	55.7	45.4
Bank Cover (%)[3]	63.3	75.0	73.3	68.7
Bank Soil Stability (%)[3]	58.3	88.3	78.3	70.5
Bank Vegetation Stability (%)[3]	70.0	85.8	79.2	76.1
Canopy Density (%)[3]	44	92	82	74
Ungulate Damage (%)[4]	33.4	1.1	6.0	18.6
Embeddedness (%)[4]	63.7	56.9	41.2	53.1
Habitat Condition Index (HCI %)[5]	52.3	61.2	58.4	57.5
Habitat Vulnerability Index (HVI%)[6]	53.3	42.9	53.0	49.7
Riparian Condition[7]	3.9	12.0	11.0	4.9
Riparian Area (ha)	5.98	0.58	0.29	6.85 (total)

[1]- <15 Good; 16-25 Fair; >26 Poor
[2]- >70% Good; 40-69% Fair; <39%Poor
[3]- >80% Good; 40-79% Fair; <39%Poor
[4]- <25% Good; 26-50% Fair; >51%Poor
[5]- >60% Good; 40-59% Fair; <39%Poor
[6]- <45% Good; 46-59% Fair; >60%Poor
[7]- 9-12 Moderately high -High; 6-8 Moderate: 0-5 Low - Moderately low

Table 4. Number, relative abundance, relative biomass, and catch per effort of fish sampled by electrofishing at Lee Valley Creek in 1995.

Reach	Species Sampled	No. Sampled	Percent of Total	Catch per Effort	Weight Sampled (g)	Percent of Total	Size Range (mm)
1	SAFO	1	100	0.7	30	100	138
2	SAFO ONAP TOTAL	9 3 12	75 25 100	6 2 8	262 76 338	77.5 22.5 100	72-205 104-149
3	NO FISH	-----	-----	-----	-----	-----	-----
Stream Total	SAFO ONAP TOTAL	10 3 13	76.9 23.1 100	2.2 0.6 2.8	292 76 368	79.3 20.7 100	72-205 104-149 -----

SAFO = *Salvelinus fontinalis* (Brook trout)
ONAP = *Oncorhynchus apache* (Apache trout)

Coyote Creek

Coyote Creek originates near the eastern slope of Escudilla Mountain on the Apache-Sitgreaves National Forests and flows in a northerly direction where it joins the Little Colorado River upstream of Lyman Lake. Approximately 16 kilometers (10 miles) of Coyote Creek are found within the Forest, and approximately eight kilometers (five miles) were inventoried during this survey. Elevations on Coyote Creek range from 2286 meters (7500 feet) to 2621 meters (10,900 feet) near the top of Escudilla Mountain. This survey began at 2408 meters (7900 feet) in elevation and ended at 2621 meters (8600 feet) in elevation, with the stream gradient averaging 3.8%. Coyote Creek is a third order stream (Strahler 1957), and the watershed consists primarily of open grasslands and ponderosa pine forests.

Apache trout were first introduced into Coyote Creek in the late 1960's (AGFD 1991). Rinne (1985) and Carmichael et al. (1993) consider the trout currently present in Coyote Creek to be pure Apache trout. This survey confirmed the Apache trout as the only fish species occupying

that portion of Coyote Creek above the fish barrier. The fish barrier was constructed in 1994, and is found in reach 1 just upstream of station 1-3 (Appendix A, Figures A-3 and A-4). In 1996, all Apache trout were removed from the intermittent reaches of Coyote Creek by the Arizona Game & Fish Department, and placed in permanent reaches, because of severe drought conditions.

Water Quality

Water quality sampling was conducted at the last station of each reach. When no water was present at the last station, the next closest station in the reach with water was sampled. Water samples were analyzed for several parameters with a Hach field test kit that utilized standard methods (APHA 1980, EPA 1979). Results for pH (hydrogen-ion concentration), alkalinity, sulphates, specific conductance, and dissolved oxygen concentrations are presented in Table 5. Parameters measured were generally indicative of moderate trout production potential. Total alkalinity values ranged from 189 mg/l to 226 mg/L, and the mean conductivity was 317 micromhos/cm. Hydrogen-ion concentrations (pH) values ranged from 7.5 to 8.8, with an average of 8.1.

Table 5. Coyote Creek Water Quality Analyses Summary, July 1995.

Station Number	1-1	2-15	3-20	4-25	5-28	6-33	7-36	Avg.
Date	7/12	7/11	7/11	7/10	7/3	7/5	7/5	---
Time	09:15	13:53	08:45	13:00	10:25	12:45	14:30	---
Water Temperature (EC)	12.0	31.0	17.7	26.0	14.0	22.0	27.7	21.5
pH	7.5	8.3	7.8	8.8	8.1	7.9	8.3	8.1
Alkalinity (mg/l)	189	276	---	223	206	199	203	216
Sulphate (mg/l)	13	7	0	6	5	5	12	7
Specific Conductance (Fmhos/cm at 25EC)	315	365	381	355	350	337	317	346
Dissolved Oxygen	6.15	7.18	8.45	6.65	7.50	7.42	6.82	7.17

Habitat

This survey consisted of 23 GAWS stations in seven different reaches. From the data collected, habitat ratings were calculated for several stream characteristics. The Habitat Condition Index (HCI) is a combined rating of six trout habitat parameters; pool measure, pool structure, gravel bottom, bank cover, bank soil stability, and bank vegetation stability. Table 6 contains the summarized GAWS data for each stream reach surveyed. For comparison, results of the 1990 stream survey are presented in Table 7 and Figure B-10. Approximately 1.5 miles of Coyote Creek were dry or intermittent during this survey, this was primarily in reaches 1 and 2. Coyote Creek provides approximately 0.06 hectares (0.2 acres) of coldwater fisheries habitat. Coyote Creek had a mean width of 0.8 m, a mean depth of 0.03 m, and a width to depth ratio of 26.7. Stream gradient averaged 3.8%, and the total riparian area was 12.02 hectares (4.86 acres). The average riparian condition rating was 9.2, which is satisfactory.

Stream reaches 1, 3 and 5 are relatively high gradient canyon reaches. Reach 1 had very little water. Of the three stations surveyed in this reach, only two station had water. Each station consists of five transects. In the two stations that had water, only four transects had any water. This may account for the low pool measure, pool structure and gravel bottom ratings. The HCI reflects this and only averaged 36.6% for the reach (Figure B-11). In reach 3, pool structure and bank vegetation stability increased in 1995. The HCI for reach 3 was 58.7% in 1995 and 59.0% in 1990 (Figure B-13). All of the habitat parameters except bank soil and vegetation stability for reach 5 decreased. The most marked decreases were seen in pool measure and pool structure. The habitat was measured as riffles. The bank cover was measured as being grass. There were shrubs and trees present in the reach, but they did not provide

Table 6. A summary of habitat conditions at Coyote Creek, July 1995.

Stream Reach	1	2	3	4	5	6	7	Total/ Stream Ave.
Reach Length (m)	1550	1965	972	1040	420	1104	1380	8431 (total)
Reach Area (m^2)	65.0	39.0	154.0	135.0	63.0	75.0	90.5	621.5 (total)
Number of Stations	3	6	3	3	2	3	3	23 (total)
Elevation (m)	2433	2471	2509	2535	2556	2571	2597	2515
Gradient (%)	3.3	2.3	4.9	4.7	5.7	3.0	3.0	3.8
Riffle (%)	0.0	16.0	62.1	28.8	50.0	49.4	0.0	29.5
Potential Spawning Area (%)	0.0	4.5	4.9	12.6	1.2	8.4	0.0	4.5
Potential Rearing Area (%)	0.5.20	11.6	23.3	26.2	0.0	0.0	4.0	9.3
Channel Width (m)	5.2	1.6	4.0	11.8	5.4	5.1	5.6	5.5
Water Width (m)	0.7	0.2	1.3	1.1	0.8	0.6	0.8	0.8
Water Depth (m)	0.01	0.0	0.03	0.06	0.05	0.06	0.03	0.03
Water Width/Depth Ratio[1]	70	0.0	43.3	18.3	16	10	26.7	26.3
Pool Measure (%)[2]	0.0	9.7	44.9	28.6	0.0	0.0	8.8	13.1
Pool Structure (%)[2]	0.0	16.7	66.7	33.3	0.0	0.0	33.3	21.4
Gravel Bottom (%)[2]	1.3	10.5	49.0	31.8	31.3	10.0	2.6	19.5
Bank Cover (%)[2]	80.0	49.6	41.7	46.7	50.0	47.5	50.0	52.2
Bank Soil Stability (%)[3]	69.2	72.1	75.0	61.7	95.0	73.3	80.0	75.2
Bank Vegetation Stability (%)[3]	69.2	72.1	75.0	59.2	93.8	78.3	80.0	75.4
Canopy Density (%)[3]	60.0	13.0	60.0	11.0	51.0	7.0	9	30.1
Ungulate Damage(%)[4]	0.5	11.5	0.00	15.1	0.0	13.9	24.2	9.3
Embeddedness (%)[4]	46.5	26.4	29.7	66.6	44.6	71.4	69.1	50.6
Habitat Condition Index (HCI%)[5]	36.6	38.4	58.7	43.5	45.0	34.9	42.5	42.8
Habitat Vulnerability Index (HVI%)[6]	58.3	61.5	64.4	60.2	67.3	58.6	59.7	61.4
Riparian Condition[7]	10	9.5	11	11	9	6	8	9.2
Riparian Area (ha)	1.71	4.32	0.78	0.73	0.50	2.32	1.66	12.02

[1]- <15 Good; 16-25 Fair; >26 Poor
[2]- >70% Good; 40-69% Fair; <39%Poor
[3]- >80% Good; 40-79% Fair; <39%Poor
[4]- <25% Good; 26-50% Fair; >51%Poor
[5]- >60% Good; 40-59% Fair; <39%Poor
[6]- <45% Good; 46-59% Fair; >60%Poor
[7]- 9-12 Moderately high -High; 6-8 Moderate
: 0-5 Low - Moderately low

dominant cover at the transects. The HCI decreased from 72.3% in 1990 to 45.0% in 1995 (Figure B-15). The embeddedness ratings for reaches 3 and 5 decreased, but increased in reach 1 (Figure B-18). The ungulate damage ratings decreased for these reaches between 1990 and 1995 (Figure B-19).

Reaches 2, 4, 6 and 7 are low to moderate gradient meadow reaches. In the six stations surveyed (30 transects) in reach 2, only 8 transects had water. This may account for the low pool measure, pool structure and gravel bottom ratings, and the subsequent low HCI (Figure B-12). The HCI for reach 2 was 38.4% in 1995, well below the Forests= minimum standard (60%), but it was up from 29.0% in 1990. In 1990, two of the six stations surveyed in reach 2 did not have water. Reach 4 of Coyote Creek was in unsatisfactory condition in 1995. All habitat parameters decreased from 1990 to 1995, except for percent gravel bottom. The most significant changes were seen in the pool measure and pool structure ratings (Figure B-14). Reach 6 also had a significant decrease in pool measure and pool structure. The percent gravel bottom, soil stability, and vegetation stability increased from 1990 to 1995 (Figure B-16). Bank cover, soil stability, and vegetation stability ratings increased in reach 7. Pool measure and gravel bottom ratings decreased, while pool structure stayed the same (figure B-17). The HCI for reach 7 increased from 41.1% to 42.5% in 1995, but is still below the Forests= minimum standard. The emdeddedness ratings in these four reaches were high (Figure B-18). The ungulate damage ratings were low in these reaches (Figure B-19).

Fish Populations

Apache trout were the only fish species captured in Coyote Creek, and the electrofishing results are presented in Table 8. A total of 47 Apache trout were captured; 13 in reach 2, 24 in

Table 7. Summary of habitat conditions at Coyote Creek, 1990.

Stream Reach	1	2	3	4	5	6	7	Total/ Stream Avg.
Riffle (%)	27.5	33.4	60.9	30.3	36.9	31.6	35.5	34.9
Potential Spawning Area (%)	8.4	12.1	30.1	6.5	13.6	2.5	21.9	12.4
Potential Rearing Area (%)	86.9	45.5	33.3	65.4	45.8	68.1	22.5	61.2
Channel Width (m)	4.5	2.5	3.9	7.6	13.0	5.2	5.0	4.9
Water Width (m)	1.4	0.3	0.9	0.9	0.8	0.8	0.5	0.8
Water Depth (m)	0.07	0.01	0.03	0.08	0.04	0.04	0.04	0.05
Water Width/Depth Ratio[1]	20.0	30.0	30.0	11.0	20.0	20.0	13.0	16.0
Pool Measure (%)[2]	48.0	0.0	55.1	55.1	83.3	63.2	22.7	46.5
Pool Structure (%)[2]	83.7	16.7	33.3	87.5	100.0	94.4	33.3	67.9
Gravel Bottom (%)[2]	16.6	12.1	52.7	30.0	41.7	7.5	19.5	21.1
Bank Cover (%)[2]	84.2	43.3	53.3	48.3	55.0	49.2	49.2	54.9
Bank Soil Stability (%)[3]	65.0	50.4	76.7	62.5	83.8	65.0	64.2	63.4
Bank Vegetation Stability (%)[3]	72.5	51.7	63.3	70.0	70.0	71.7	57.5	63.6
Canopy Density (%)[3]	90	10	63	18	56	10	10	48
Ungulate Damage(%)[4]	30.2	47.6	22.8	48.9	34.6	40.5	48.1	40.2
Embeddedness (%)[4]	37.6	79.3	47.0	61.9	52.6	75.9	71.9	55.8
Habitat Condition Index (HCI%)[5]	61.7	29.0	59.0	55.8	72.3	58.5	41.1	55.3
Habitat Vulnerability Index (HVI%)[6]	57.4	59.1	49.9	56.2	55.1	58.3	50.5	55.6
Riparian Condition[7]	8.7	2.2	9.1	6.0	9.0	2.0	3.7	6.1
Riparian Area (ha)	2.33	1.97	1.75	0.62	0.34	0.55	0.97	8.53 (total)

[1]- <15 Good; 16-25 Fair; >26 Poor
[2]- >70% Good; 40-69% Fair; <39%Poor
[3]- >80% Good; 40-79% Fair; <39%Poor
[4]- <25% Good; 26-50% Fair; >51%Poor
[5]- >60% Good; 40-59% Fair; <39%Poor
[6]- <45% Good; 46-59% Fair; >60%Poor
[7]- 9-12 Moderately high -High; 6-8 Moderate
: 0-5 Low - Moderately low

reach 3, nine in reach 4, and one in reach 5. No fish were captured in reach 1, reach 6, or reach 7. Harper (1978) determined that Apache trout reach maturity at three years of age and approximately 130 mm in length. Of the 47 Apache trout captured, 13 were 130mm or greater in length. These 13 Apache trout comprised 60% of the total biomass. Only eight of the Apache trout captured were fry (young of the year), and they only occurred at station 18 in reach 3.

Table 8. A summary of fish sampling results at Coyote Creek in July 1995.

Reach	Species	No.	Percent	Catch per effort*	Weight sampled (g)	Percent of Total	Size Range (mm)
1	NO FISH	----	----	----	----	----	----
2	ONAP	13	100	8.7	420	100	95-215
3	ONAP	24	100	8.0	239	100	30-140
4	ONAP	9	100	6	217	100	90-150
5	ONAP	1	100	1	116	100	221
6	NO FISH	----	----	----	----	----	----
7	NO FISH	----	----	----	----	----	----
STREAM TOTAL	ONAP	47	100	4.5	1010	100	30-221

ONAP = *Oncorhynchus apache* (Apache trout)

*Number of fish per 100 meters.

Mamie Creek

Mamie is in southeastern Apache County on the Forest, and is a northeasterly flowing tributary to Coyote Creek. The Mamie Creek watershed is approximately 11 square kilometers (4 square miles). Elevations range from approximately 2484 meters (8150 feet) at the confluence with Coyote Creek, to more than 3250 meters (10,600 feet) near the top of Escudilla Mountain. The last sampling station in this survey occurred at 3018 meters (9,900 feet) in elevation (Appendix A, Figures A-5 and A-6).

Mamie Creek is a small second order stream, with an average gradient of 8.5% over the length surveyed. Mamie Creek contains four distinct reaches; reach 1 is a meadow reach, and reaches 2, 3, and 4 are higher gradient canyon reaches. The watershed consists primarily of mixed-conifer forests.

Water Quality

Water quality analyzes were conducted at the last station of each reach. Results for pH (hydrogen-ion concentration), alkalinity, sulphates, specific conductance, and dissolved oxygen concentrations are presented in Table 9. Parameters measured were indicative of low to moderate trout production potential. Total alkalinity values ranged from 82 mg/L to 132 mg/L, and the mean conductivity was 136 micromhos/cm. Hydrogen-ion concentrations (pH) values were relatively stable, averaging 8.19 and ranging from 8.10 to 8.26.

Table 9. Mamie Creek Water Quality Analyses Summary, June 1995.

Station Number	1-1	2-10	3-15	4-22	Stream Avg.
Date	6/27	6/21	6/21	6/29	---
Time	08:30	11:14	13:00	12:20	---
Water Temperature (EC)	10.0	10.6	15.0	10.0	11.4
pH	8.26	8.19	8.10	8.20	8.19
Alkalinity (mg/l)	105	83	132	82	101
Sulphate (mg/l)	7.0	5.0	1.0	8.5	5.4
Specific Conductance (Fmhos/cm at 25EC)	187	180	166	11	136
Dissolved Oxygen	9.61	8.50	8.08	8.67	8.72

Habitat

This survey consisted of 15 stations in four different stream reaches. From the data collected, habitat ratings were calculated for several stream characteristics. Table 10 contains the summarized GAWS data for each stream reach surveyed. For comparison purposes, results of the 1990 stream survey are presented in Table 11.

Mamie Creek supported a riparian area that was approximately 52.37 hectares (129.41 acres), and had an average riparian condition rating of 10.5. This is a satisfactory rating, and an increase over the 1989 survey rating of 8.2 (unsatisfactory). Mamie Creek also provides approximately 0.06 hectares (0.13 acres) of coldwater fisheries habitat. At base flow it was a shallow stream with an average width of 1.1 meters, an average depth of 0.04 meters, and an average width to depth ratio of 29.8.

Reach 1 is a low gradient meadow stream channel that is heavily grazed by livestock. The stream channel has been downcut and widened, and is still eroding with steep unvegetated banks. At base flow reach 1 had an average width of 1.0 meters, an average depth of 0.03 meters, and an average width to depth ratio of 33.3. Pool measure and pool structure ratings were both zero, indicating very poor conditions in terms of pool habitat (Figure B-24). The HCI was only 33.3%, well below the Forest Plan standard of a minimum of 60%. Bank soil stability

and bank vegetation stability ratings were only fair, averaging 52.5% and 47.5% respectively. The riparian condition rating was 10, which is satisfactory; and reach 1 contained 37.85 hectares (93.53 acres) of riparian habitat and 0.01 hectares (0.02 acres) of coldwater fisheries habitat (Tables 10 and 11).

Reach 2 is a low gradient canyon reach that had an average gradient of 3.0%. At base flow reach 2 was 1.0 meters in width and 0.05 meters in depth, with an average width to depth ratio of 20.0. Pool measure and structure ratings were very low, indicating poor pool habitat conditions. The HCI was 44.0%, a decrease from the 59.2% obtained in the 1989 survey. Bank

Table 10. A summary of habitat conditions at Mamie Creek, 1995.

Stream Reach	1	2	3	4	Total/ Stream Avg.
Reach Length (m)	1237	3054	585	2360	7236 (total)
Reach Area (m^2)	78.0	247.5	124.0	207.0	656.5 (total)
Number of Stations	2	6	3	4	15 (total)
Elevation (m)	2499	2560	2682	2789	2633
Gradient (%)	2.2	3.0	5.2	8.9	4.8
Riffle (%)	91.2	93.2	92.4	94.0	92.7
Potential Spawning Area (%)	27.4	29.9	40.4	51.8	37.4
Potential Rearing Area (%)	0.0	3.5	0.0	4.6	2.0
Channel Width (m)	9.7	3.9	3.5	4.0	5.3
Water Width (m)	1.0	1.0	1.0	1.3	1.1
Water Depth (m)	0.03	0.05	0.03	0.04	0.04
Water Width/Depth Ratio[1]	33.3	20.0	33.3	32.5	29.8
Pool Measure (%)[2]	0.0	7.6	0.0	12.0	4.9
Pool Structure (%)[2]	0.0	16.7	0.0	25.0	10.4
Gravel Bottom (%)[2]	47.0	63.3	63.4	69.5	60.8
Bank Cover (%)[2]	52.5	65.8	70.0	59.4	61.9
Bank Soil Stability (%)[3]	52.5	56.7	80.0	74.4	65.9
Bank Vegetation Stability (%)[3]	47.5	54.2	80.8	70.0	64.2
Canopy Density (%)[3]	46	64	66	66	60.5
Ungulate Damage(%)[4]	17.5	7.4	1.7	8.1	8.7
Embeddedness (%)[4]	34.7	22.6	28.3	25.8	27.9
Habitat Condition Index (HCI%)[5]	33.2	44.0	49.0	51.7	44.5
Habitat Vulnerability Index (HVI%)[6]	51.6	62.2	59.5	66.1	59.9
Riparian Condition[7]	10	11	11	10	10.5
Riparian Area (ha)	37.85	9.56	1.01	3.95	52.37 (total)

[1]- <15 Good; 16-25 Fair; >26 Poor
[2]- >70% Good; 40-69% Fair; <39%Poor
[3]- >80% Good; 40-79% Fair; <39%Poor
[4]- <25% Good; 26-50% Fair; >51%Poor
[5]- >60% Good; 40-59% Fair; <39%Poor
[6]- <45% Good; 46-59% Fair; >60%Poor
[7]- 9-12 Moderately high -High; 6-8 Moderate: 0-5 Low - Moderately low

Table 11. A summary of habitat conditions at Mamie Creek, 1989 Survey.

Stream Reach	2	3	Total/ Stream Avg.
Riffle (%)	58.5	66.3	59.7
Potential Spawning Area (%)	14.6	34.8	17.8
Potential Rearing Area (%)	46.5	34.6	44.6
Channel Width (m)	2.6	1.6	2.4
Water Width (m)	0.9	0.8	0.9
Water Depth (m)	0.04	0.03	0.04
Water Width/Depth Ratio[1]	23.0	27.0	23.0
Pool Measure (%)[2]	54.2	53.4	54.1
Pool Structure (%)[2]	71.0	59.0	69.1
Gravel Bottom (%)[2]	36.9	50.2	38.9
Bank Cover (%)[2]	81.3	90.0	82.7
Bank Soil Stability (%)[3]	51.7	66.7	54.1
Bank Vegetation Stability (%)[3]	60.0	73.3	62.1
Canopy Density (%)[3]	95	94	95
Ungulate Damage(%)[4]	13.7	15.2	13.9
Embeddedness (%)[4]	65.2	54.7	63.6
Habitat Condition Index (HCI%)[5]	59.2	65.4	60.2
Habitat Vulnerability Index (HVI%)[6]	44.6	44.1	44.1
Riparian Condition[7]	8.1	8.8	8.2
Riparian Area (ha)	6.72	0.99	7.71 (total)

[1]- <15 Good; 16-25 Fair; >26 Poor
[2]- >70% Good; 40-69% Fair; <39%Poor
[3]- >80% Good; 40-79% Fair; <39%Poor
[4]- <25% Good; 26-50% Fair; >51%Poor
[5]- >60% Good; 40-59% Fair; <39%Poor
[6]- <45% Good; 46-59% Fair; >60%Poor
[7]- 9-12 Moderately high -High; 6-8 Moderate: 0-5 Low - Moderately low

soil stability and bank vegetation stability ratings were also fair in this reach, averaging 56.7% and 54.2% respectively (Figure B-25). Embeddedness ratings decreased from 65.2% in 1989 to 22.6% in 1995 (Figure B-26). The riparian condition rating increased to 11 (satisfactory), this is an increase form the 8.1 value obtained in the 1989 survey (Tables 10 and 11).

Reach 3 is a canyon reach similar to reach 2 but with a higher gradient, averaging 5.2%. At base flow reach 3 was 1.0 meters in width and 0.03 meters in depth, with an average width to depth ratio of 33.3. Reach 3 contained 1.01 hectares (2.50 acres) of riparian habitat, and 0.01 hectares (0.03 acres) of coldwater fisheries habitat. Pool measure and pool structure ratings were zero, indicating very poor pool habitat conditions. The HCI in this reach was 49.0%, a decrease from the 1989 survey, which was 65.4%. Bank soil stability and bank vegetation stability ratings were good, averaging 80.0% and 80.8% respectively (Figure B-26). The riparian condition rating was 11 (satisfactory), an increase from the 8.8 (unsatisfactory) rating from the 1989 survey.

Reach 4 was the uppermost reach surveyed on Mamie Creek. It is a steep canyon reach, with an average gradient of 8.9%. It had an average width of 1.3 meters and average depth of 0.04 meters, and an average width to depth ratio of 32.5. Reach 4 contained 3.95 hectares (9.76 acres) of riparian habitat, and 0.02 hectares (0.05 acres) of coldwater fisheries habitat. Both pool measure and pool structure ratings were poor, indicating poor pool habitat conditions. The HCI in this reach was 51.7, the highest of the four reaches surveyed; but still below the Forest minimum of 60%. Both bank soil stability and bank vegetation stability ratings were fair, averaging 74.4% and 70.0% respectively (Figure B-27). The riparian condition rating was 10, which is satisfactory.

Fish Populations

Apache trout were the only fish species captured in Mamie Creek, and the electrofishing results are presented in Table 12. A total of 12 Apache trout were captured; three in reach 2, one in reach 3, and eight in reach 4. No fish were captured in reach 1, and no fry (young of the year) were captured in any reaches. Six of the 12 Apache trout captured were 130 mm in length or

greater. Harper (1978) determined that to be the length at maturity for Apache trout. These six mature apache trout comprised 79% of the total biomass.

Discussion

Lee Valley, Coyote, and Mamie Creeks are all managed under the AFeatured Species Concept@ of the Arizona Coldwater Sportfisheries Strategic Plan (AGFD 1990). The Lee Valley Creek and Coyote/Mamie Creek populations of Apache trout are two of the 30 populations considered necessary for the recovery and delisting of this threatened species (USFWS 1983). A viable population of wild Apache trout is dependent upon maintaining riparian and stream habitat in a high quality state.

Table 12. Summary of Electrofishing results on Mamie Creek from June 1995.

Reach	Species Sampled	No. Sampled	Percent of Total	Catch per Effort	Weight Sampled (g)	Percent of Total	Size Range (mm)
1	NO FISH	0	0	0	0	0	0
2	ONAP	3	100	1	81	22.3	91-155
3	ONAP	1	100	0.7	12	3.3	96
4	ONAP	8	100	4	271	74.4	70-180
STREAM TOTAL	ONAP	12	100	1.6	364	100	----

The HCI-s and trout standing stocks indicated that aquatic habitat in the three streams surveyed were in poor to fair condition. The average HCI for Lee Valley Creek was 48.5%, Coyote Creek was 42.8%, and Mamie Creek was 44.5%. There were a total of 14 reaches surveyed in all three streams, and none were above the 60% minimum standard for Forest trout streams. Twelve of the 14 reaches surveyed had been previously surveyed in 1989-90. Of these twelve reaches, three showed increases in the HCI, and nine showed decreases in the HCI-s. Trout standing biomass was poor, averaging well below 1 g/m2 in Lee Valley and Mamie Creeks, and only 1.6 g/m2 in Coyote Creek. These poor habitat and fish population conditions

can be attributed to several factors: low pool measure and pool structure ratings, low bank soil stability and bank vegetation stability ratings, high embeddedness and excessive sediment loading, high water temperatures; and to a lesser extent, high ungulate damage and low riparian condition.

The Apache Trout Habitat Improvement Plan designated critical stream reaches on Apache trout streams. Critical reaches were defined as reaches having physical parameters that made them sensitive to livestock grazing (USFS 1995). Reach 1 on Lee Valley Creek and reaches 2, 4, 6, and 7 on Coyote Creek were designated critical reaches. No critical reaches were designated on Mamie Creek. Reach 1 on Mamie Creek and reaches 2 and 7 on Coyote Creek showed increases in the HCI ratings, while reaches 4 and 6 on Coyote Creek showed decreases in the HCI ratings. During the summer of 1996 livestock exclosures were constructed on reaches 4 and 6 of Coyote Creek, and a small spring exclosure (approximately two acres) was constructed on reach 7.

Overall riparian, stream, and fisheries habitat conditions on the streams surveyed were poor to fair when compared to Forest Plan standards and guidelines. Although the riparian condition ratings did show increases in all the streams surveyed, and were consistently in the high to moderate ratings. Improvement in both watershed and stream conditions will be necessary to move fisheries habitat conditions towards the minimum standards provided for in the Forest Plan. Watershed improvements should include road and headcut/gully relocation, obliteration, or stabilization where adversely impacting riparian and fisheries habitat. Watershed management activities that would create more viable flows needed for maintaining fisheries should also be

considered. Other management and land use activities should be evaluated and allow for and maintain the minimum habitat conditions and satisfactory riparian conditions.

Since the 1995, survey some new management activities have taken place that may affect these streams. The Allotment Management Plan for the Voigt Allotment (Lee Valley Creek) is currently under revision. One of the alternatives in the Environmental Assessment is not to graze the Lee Valley pasture. Lee Valley Creek is a part of the Mount Baldy Wilderness Area. As mentioned above, reaches 4 and 6 of Coyote Creek were recently exclosed from livestock use. Reaches 5 and 7 are a part of the North Circe Pasture which is considered a ASpecial Emphasis@ pasture. This pasture is grazed no more than seven days a year. The remainder of reaches on Coyote and Mamie Creek are part of the East Loco Pasture. This pasture is grazed for approximately eight days per year. This allotment recently underwent analysis and the number of livestock permitted was reduced. These management changes will need to be evaluated in terms of any effects (beneficial or negative) to fish habitat. The new livestock exclosures are being monitored regularly for bank stability and any other noticeable changes. All of these streams are scheduled for another GAWS survey in the year 2000. Those surveys should help establish whether the new management activities recently implemented are meeting habitat objectives.

Literature Cited

AGFD (Arizona Game and Fish Department). 1990. Coyote Creek Fish Management Report.

AGFD (Arizona Game and Fish Department). 1990. Arizona Coldwater Fisheries Strategic Plan, 1991-1995. Arizona Game and Fish Department. Phoenix, AZ. 30 p.

AGFD (Arizona Game and Fish Department). 1991. Lee Valley Creek Fish Management Report.

APHA (American Public Health Association). 1980. Standard Methods for the Examination of Water and Wastewater. 15th edition. American Public Health Association. Washington, D.C. 1134 p.

Carmichael, G. J., J. N. Hanson, M. E. Schmidt, and D. C. Morizot. 1993. Introgression among Apache, Cutthroat, and Rainbow Trout in Arizona. Transactions of the American Fisheries Society. 122:121-130.

Harper, K. C. 1978. Biology of a Southwestern Salmonid, Salmo apache (Miller 1972). In J. R. Moring (editor): Proceedings Wild Trout-Catchable Trout Symposium, Eugene, Oregon.

Rinne, J. N. 1985. Variation in Apache Trout Populations in the White Mountains, Arizona. North American Journal of Fisheries Management. 5:146-158.

Strahler, A. N. 1957. Quantitative analysis of watershed geomorphology. Transaction American Geophysical Union. 38:913-920.

U. S. Fish and Wildlife Service. 1983. Arizona Trout Recovery Plan, Albuquerque, New Mexico.

U. S. Forest Service. 1995. Apache Trout Habitat Improvement Plan. Apache-Sitgreaves National Forests.

U. S. Forest Service. 1989. Apache-Sitgreaves National Forests Land and Resource Management Plan. Southwestern Region.